SCIENCE

VOL. 80 FRIDAY, JULY 27, 1934 No. 2065

Science and Culture: PROFESSOR JOHN R. MURLIN 81

Nomenclature of the Hydrogen Isotopes and Their Compounds: E. J. CRANE 86

Scientific Events:

The Centenary of Photography; Visit of American Foresters to Germany and Austria; Exhibit of the Patent Office at the Chicago World's Fair; The Establishment of a Forest Shelter Belt; Report of the Chief of the Office of Experiment Stations; Summer Meeting of the Botanical Society of America at Toronto 89

Scientific Notes and News 92

Discussion:

The Pleistocene Long Valley Lake in Eastern California: DR. EVANS B. MAYO. *Do Chromatophore Walls Cause Movement of Pigment Granules?:* DR. EARL H. HERRICK. *Pancreatectomy—a Warning:* DR. G. C. RING. *The Tropical Rat Flea in the Interior of the United States:* ROBERT L. ROUDABUSH and PROFESSOR ELERY R. BECKER. *University of Rochester Fiji Expedition:* DR. J. EDWARD HOFFMEISTER and DR. HARRY S. LADD 95

Scientific Apparatus and Laboratory Methods:

Rational Tray Sizes for Geologic Specimens: DR. CHESTER K. WENTWORTH. *Apparatus for Studying the Effect of Increased Atmospheric Pressure upon the Developing Hen Egg:* DR. BERT CUNNINGHAM. *Mariotte's Bottle:* E. L. MCCARTHY 98

Special Articles:

On the Extent of the Validity of the "Rule of Shift": DR. P. A. LEVENE, ALEXANDRE ROTHEN and DR. G. M. MEYER. *Pseudorabies as a Contagious Disease in Swine:* DR. RICHARD E. SHOPE. *Crossovers in Male Drosophila melanogaster Induced by Heat:* PROFESSOR A. FRANKLIN SHULL and MAURICE WHITTINGHILL. *Susceptibility to Poison Ivy and Poison Oak:* DR. W. C. SPAIN, DR. J. M. NEWELL and MIRIAM MEEKER 101

Science News 5

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

SCIENCE AND CULTURE[1]

By Professor JOHN R. MURLIN

DIRECTOR OF THE DEPARTMENT OF VITAL ECONOMICS, UNIVERSITY OF ROCHESTER

"ON the truth of nature," declared Sir Francis Bacon over 300 years ago, "we shall build a system for the general amelioration of mankind." Bacon was voicing the first significant dissent from the old authoritarianism which had come down from Aristotle. "Let us look at the facts and then draw our conclusions," said Bacon, and while he was writing on the inductive method Harvey was putting it into practise in his demonstration of the circulation of the blood, "on the truth of nature." Descartes, having set analytical geometry on its conquering way 50 years later, exclaimed: "When we know the force and action of fire, water, air, the stars, the heavens and all other objects as we now know the various trades, we shall make ourselves masters and possessors of life. . . . This will not be solely for the pleasure of enjoying with ease . . . the good things of the world [he continues], but principally for the preservation and improvement of human health which is both the foundation of all other goods and the means of strengthening the human spirit." By a slight paraphrasis we may find in Descartes' words an outline of the great services of science during these 300 years: (1) Contributing to the ease and comfort and convenience of life; (2) the improvement of human health; and (3) strengthening the human spirit. Does any one doubt the first of these great services? Let him look back only a generation to kerosene lamps, wood stoves, horse and buggy transportation. Or the second? Let

[1] A dedicatory address delivered on the occasion of opening the new science building at Ursinus College, Collegeville, Pa., June 5, 1933.

him recall the typhoid fever epidemics of only 30 years ago—the last one in Philadelphia occurred while I was there as a student in 1900; the enormous mortality from tuberculosis only twenty years ago; the ravages of rickets in children of the tenements only ten years ago—all these and many other diseases either wholly brought under control, to remain so (if we remain civilized), or rapidly yielding to the science of prevention and treatment. True, there is much for medical science yet to do. Cancer, influenza and pneumonia remain unconquered, but there is definite hope in the case of pneumonia at least, and scores of scientific men are concentrating on cancer. Nobody doubts that the means of prevention or cure some day will be found.

May I point out here the intimate and wholly surprising relation between the economic depression and health and allude briefly to a personal experience? Late in November, 1932, I was summoned to Washington by the Surgeon-General of the U. S. Public Health Service and requested to represent him at a conference called by the Health Organization of the League of Nations in Berlin early in December. Dr. Kenneth Blackfan of Harvard also was invited. We met the representatives of Germany, France, Austria, Italy, England, Holland, Denmark and Belgium at the League office in Berlin on December 5, 6 and 7. The situation which the Permanent Health Committee of the League had discovered at its meeting in Geneva in September was this. The death rates and sickness rates of all the countries most affected by the economic crisis had steadily decreased since its precipitation in 1929. In Paris, Amsterdam, Warsaw, Cologne, Budapest, Milan and Prague—seven great cities of Europe which had been most carefully studied—there was, without exception, lower morbidity and lower mortality since 1929 than for the five-year average just before that date. With less money to buy food, less for clothing, overcrowding because of the necessity to save on rent, people were not dying so fast or getting sick so much as when they were prosperous. Here appeared a great mystery. But surely if people were not actually reporting themselves ill, they must at least be suffering from poor nutrition. Indeed, there were already many reports to this effect, and soon illness might break out with greater intensity.

The conference which we attended was given the task to lay out a program of study by which the nutritional status of necessitous people of the different countries could be rapidly determined and compared. A survey containing many of the features of our report[2] recently has been made in nine of our American cities. The situation with respect to tuberculosis was of special interest. This disease more than any other has declined more rapidly, as judged by the number of open cases reported, since 1929 than before. The principal reason seems to be this: *Compelled to rest because he has had no work,* the exposed person has resisted the disease better than if he were employed.[3] What does the physician do with us, if he finds tuberculosis already established in the lung? He puts us to bed and compels us to rest for several months. Nobody had ever thought of putting whole populations to bed as a means of prevention of tuberculosis; but that in effect is just what the depression has done.[4] Could anybody offer a stronger argument for the "amelioration of mankind," for mitigation of the storm and stress of life for multitudes of workers?

But my main theme has to do with the third great service of science, *to strengthen the human spirit.* Here lies the realm of true culture. Suppose we accept the definition of culture which was first given, I believe, by Matthew Arnold: Culture is the criticism of life, that is, criticizing life so as to choose what is worth while and eliminate that which is not. Without regard to material welfare what can these young men and young women of Ursinus gain from science that will strengthen this kind of a life? Three sources of strength at least. The first is confidence that the solution of life's problems lies in the use of reason, not passion, however lofty, nor propaganda, however clever. What better method of gaining confidence in the human mind than constant contact with the great masters of science who have achieved greatly with their minds. There is nothing so good as example in the application of common sense, and science, said Huxley, is only trained and organized common sense.

Observe Harvey laboriously studying the valves of all the veins of the body. All, without exception, open toward the heart. What could it mean but that the blood flows through the veins toward the heart? He grasped the blood vessels between his fingers on one side of a beating heart; the heart failed to fill. He grasped them on the other side; the heart failed to empty. What could it mean save that the first set of vessels furnishes blood to the heart; the second set receives it from the heart? Finally he placed a light bandage about the arm, the hand became warm and suffused with blood; he drew the bandage tight and the hand became cold and pale. What could it mean save that the superficial veins compressed by the light bandage carry blood up the arm from the hand, and the deep-lying artery, compressed only by the tight

[2] *Quarterly Bulletin of the Health Organization of the League of Nations,* Vol. II, p. 116.

[3] "The Economic Depression and Public Health," memorandum prepared by the Health Section, *Quarterly Bulletin of the Health Organization, League of Nations,* I, No. 3, p. 436; *ibid.,* I, No. 4, p. 507, 1932.

[4] Obviously this does not express the whole truth regarding tuberculosis.

bandage, carries blood down the arm to the hand. Putting all these observations together, what could be the common-sense meaning save that the blood circulates round and round, ceaselessly flowing. Now perfectly clear to us, these matters once were completely obscured in uncertainty, because nobody until Harvey had the audacity to question the ancient doctrines of Aristotle and Galen, to trust his own senses and draw his own perfectly obvious common-sense conclusions. Can you imagine how that triumph strengthened the human spirit, gave it courage to seek the truth of nature at first hand?

For an entirely different picture of human audacity and triumph of mind observe Newton weighing the moon. The story as told by Voltaire, you remember, is that seeing an apple fall from a tree, Newton was led to wonder if the same force which pulls the apple to the earth may not extend its influence as well into great distances, and apply, for example, to the moon, or possibly to the still more distant heavenly bodies.[5] Obviously, said Newton, some force pulls the moon constantly toward the earth; otherwise it would fly off at a tangent, as a piece of mud flies off a carriage wheel, and it would never return. But it does return every 28 days.

The thought which came to his mind was this: Let me make a diagram illustrating the orbital course of the moon for a given period of time—say one minute. I shall then find that the moon departs from a straight line by a measurable distance; that is to say, it is pulled toward the earth by an amount which represents the difference between its observed position and the position it would have had, if its course were tangential. That difference, that fall every minute should agree with the law of inverse squares as do objects near the earth. The problem is a perfectly simple one which any freshman who knows his trigonometry can do. Newton undertook this calculation of the moon's fall, as he called it, first in 1666 and found, using the values then available for the moon's distance and the earth's radius, that the moon should fall toward the earth 13 feet every minute. On the supposition that the force of gravity decreases inversely as the square of the distance which Newton had found to be true for falling bodies at the surface of the earth, the fall should have been a little over 15 feet. I have known a good many freshmen who would let it go at that. The agreement was not good enough for a Newton and the problem never wholly escaped from his mind. Sixteen years later, upon learning that a French astronomer, Picard, had made more accurate measurements of the earth's dimensions (finding, for example, that 1° of the earth's meridian was actually 69.1 miles instead of 60 miles, which was the value Newton had used to get the radius), he at once took up again the problem of the falling moon. As he proceeded with his calculations he became more and more certain that this time the calculated displacement would agree with his law of inverse squares. The story goes, you remember, he was so completely overwhelmed with emotion that he was forced to ask a friend to complete the calculation. Can one imagine that emotion? For the first time the human mind had demonstrated to itself the obedience of a heavenly body to the same law that governs the falling of an apple from a tree. Newton saw that this same law probably compelled all heavenly bodies to their orbits as, indeed, was subsequently proved. What an uplift to the human spirit! LaGrange, who frequently asserted that Newton was the greatest genius that ever lived, used to add, "and the most fortunate, for nobody ever again could be the first to set the world in order."[6] The reflective mind captures the truth. Newton's mind by previous training and reflection was prepared for the incident of the falling apple. He himself tells us he was led to formulate the law of gravitation by "intending" his mind steadily to the problem for long hours at a time.

The story of Harvey's and Newton's discoveries illustrates early but outstanding successes of what we call to-day the research mind. Starting with an observation which may have been accidental or the result of mere curiosity, the research mind, unlike the ordinary mind, is compelled by some inner feeling of dissatisfaction to repeat and then to reflect upon the observation until an explanation is suggested. This may lead to experiment as in Harvey's case or to mathematical search for proof as in Newton's. Once conviction of a new truth is reached, clearness and forcefulness of presentation and courage in its defense bring the reward of recognition.

Seen from our present position, what made Harvey's and Newton's discoveries in their respective fields stand out like beacons on the dark coast of ignorance was the completeness of their proofs. When either of them had finished with a subject there was no longer any room for reasonable doubt.

We move forward 200 years. We are now at the beginning of the modern period of experimentation in biological science. Observations without number have been recorded, and Darwin has used many of them to prove that new species arise from old. If we wish to know *how* such a thing as the origin of new species could occur we must resort to experimentation. Incidentally, the new science of genetics is now ready to prove to you, not only that new species do occur, but how. If Bryan had lived only a few years more his challenge to the biologist to show him a single new species could have been answered with a number of

[5] Henry Smith Williams, "A History of Science," New York, 1904, II, 237.

[6] *Ibid.*, II, p. 250.

them, produced in the laboratory or the experimental field outdoors.

Observe the experimentalist at work. Let me give you two illustrations from France—Claude Bernard, the greatest physiologist of his time and founder of experimental medicine, and Louis Pasteur, the great chemist, biologist and founder, with Koch, of the science of bacteriology. Bernard was a man of marvelous skill in operative procedures. But he was much more, and we are not interested so much in his hands as in his mind. Let us see how his mind worked. As he himself has told us, "To the observer brooding over the phenomena which he has witnessed, there comes the thought that if a certain state of things were supposed to exist or a certain sequence of events were supposed to take place, the occurrence of the phenomena as witnessed would necessarily follow," and forthwith the scientific mind sets about to seek for evidence that the supposed state of things does exist or the supposed sequence of events does take place. "Observation starts an hypothesis and experimentation tests whether the hypothesis be true."

Bernard himself one day observed that the blood of a dog coming from the liver contained more sugar than the blood entering that organ, although the dog had been fed no carbohydrate. How could this be? The liver must produce sugar out of something else. What could that substance be? Possibly meat—the hypothesis. He feeds a dog on nothing but meat. Now no sugar at all is in the alimentary tract, no sugar passing from it to the liver—the experiment; and here's the answer, much sugar still coming out of the liver. The hypothesis is now a fact. The liver does produce sugar from protein, and at once we have learned why the diabetic person suffers emaciation, and a whole new field of chemical transformations in the body is opened up for further investigation. That field we now call intermediary metabolism and it answers such questions as these; how does the protein of the ox which you eat as beefsteak get transformed into substance of your own muscle? One crucial fact thoroughly proved and a thousand additional facts become available; they fall into line. Thus does knowledge grow and become organized into science.

In 1879 Pasteur was engaged in the study of chicken cholera. Returning from a vacation he found that some of his cultures of the cholera organism had become sterile. He could not produce the disease from them. About to throw away these old cultures, it occurred to him that it might be well to see whether a fresh young culture would produce the disease in chickens which resisted the old culture. To his amazement they resisted, while other chickens not treated with the old culture succumbed. With one blow not only chicken cholera was controlled, but the great principle of vaccination was explained.[7] DuClaux, the distinguished pupil of Pasteur, has written a book about him entitled "The History of a Mind." "What secret instinct, what spirit of divination," asks DuClaux, "impelled Pasteur to knock at this door which was waiting to be opened?" The answer is, the subconscious mind influenced by the incessant ponderings which had been going on in the conscious realm, coupled with the power of imagination. As Pasteur himself expresses the thought:

> The illusions of the experimenter form a great part of his power. These are the preconceived ideas which serve to guide him. Many of them must vanish in the long path which he must travel, but one fine day he discovers and proves that some of them are adequate to the truth. Then he finds himself master of facts and of new principles, the applications of which, sooner or later, bestow their benefits.[8]

It should be our aim in our teaching to preserve the atmosphere of the great minds of science, and we should not omit to study their lives constantly. Not having time in the curriculum for this, it has been our custom for many years to gather the staff and graduate students at our house once a month for readings and discussion in the history of science and particularly in the lives and works of the great men of science. Confidence in these great minds, which have known how to draw inference from demonstrated fact, how to apply common sense, how to knock at doors ready to be opened, is an essential part of the culture of modern education. For this is a confidence each of us should have in his own mind.

The second source of strength to the human spirit which science ought to furnish is the simple, unaffected pleasure of finding things out for oneself. Put the question to any one of the great scientists of the past, Why did you labor so long and so painfully at this problem of yours? Hear Harvey's answer: "It is sweet not merely to toil, but to grow weary, when the pains of discovering are amply compensated by the pleasure of discovery." When Pasteur separated from his mixture of tartaric acid crystals those which had right-handed hemihedral facets from those which had the left-handed and found that the former rotated polarized light to the right and the latter rotated it to the left, just as he had predicted, he received such a shock of pleasure that he left the laboratory immediately, incapable of applying his eye again to the polariscope. He was simply overwhelmed with joy. It was a game—an intellectual contest with nature—he had put the question in such a way that she was compelled to answer and to answer in the way he had guessed. It was the joy of conquest.

[7] E. DuClaux, "Pasteur: The History of a Mind," p. 281; translated by Erwin F. Smith, Philadelphia, 1920.
[8] E. DuClaux, *ibid.*, p. 280.

Listen to Kepler when he had completed the evidence which established his third law of planetary motion:

> What I prophesied two-and-twenty years ago . . . at length I have brought to light and recognized its truth beyond my most sanguine expectations. It is not 18 months since I got the first glimpse of light, 3 months since the dawn, very few days since the unveiled sun burst upon me. Nothing holds me; I will indulge my sacred fury.

Again the joy of conquest by one's own strength. This is still the attitude of the scientist. Dr. A. V. Hill, probably the greatest living biophysicist, expressed it well a few years ago by saying that men work at these problems mainly "because it is amusing."[9] We have encouraged our young men and women to rejoice in physical conquest. Have we taught them to rejoice equally in mental conquest? Why not?

I have spoken of scientific research as a game. Our laboratories, even the elementary laboratories, must be pervaded with the atmosphere of research. We must encourage the student to see for himself and reason from the observation to the explanation—for the pure joy of arriving at the answer for himself—just as on the playground, we encourage him to carry the ball, to sprint, pole vault, himself. Here is Huxley's description of the great game:

> The life, the fortune and the happiness of every one of us depends on our knowing something of the rules of a game infinitely more complicated than chess. It is a game which has been played for untold ages, each man and woman of us being one of the two players in a game of his or her own. The chess-board is the world, the pieces are the phenomena of the universe, the rules of the game are what we call the laws of nature. The player on the other side is hidden from us. We know that his play is always fair, just and patient. But we also know, to our cost, that he never overlooks a mistake or makes the smallest allowance for ignorance. To the man who plays well, the highest stakes are paid, with that sort of overflowing generosity with which the strong delight in strength. And one who plays ill is checkmated—without haste, but without remorse. My metaphor will remind you of the famous picture in which a great painter has depicted Satan playing at chess with man for his soul. Substitute for the mocking fiend in that picture a calm, strong angel who is playing for love, . . . and would rather lose than win, and I should accept it as an image of human life. Well, what I mean by education is learning the rules of this mighty game. In other words, education is the instruction of the intellect in the laws of nature, under which name I include not merely things and their forces but men and their ways.

[9] A. V. Hill, "Muscular Movement in Man," p. 1, New York, 1927.

And a little farther on it is added that "a liberal education should teach us to love all beauty, whether of nature or of art."[10] Professor Archibald Henderson recently has expressed this thought something as follows: "If art be defined as man's joy in the pursuit of beauty, science is the expression of man's joy in the pursuit of truth."[11]

The third source of strength to the human spirit which may be derived from science is the love of truth—not as something of one's own to be defended and advocated, but as something universal, belonging to all. Just as the player on a football team very properly takes pride in his own contribution, his higher motive is to win for his college—something bigger than himself. So the scientist, with a just pride in his own work and pardonable pleasure in winning the game—the true scientist thinks mainly of establishing truth for what good it may bring to his fellow man. Could Harvey claim that the circulation of the blood was his own property? Could Newton secure a patent on the law of gravitation?

We are learning slowly that it doesn't matter whose truth it is that prevails so much as it matters that we find truth which all fair minds can accept. The depression from which we are beginning to emerge has taught us that it is not important whether Democratic theories of government or Republican shall prevail—we are concerned rather to find a plan which will work. What if it does require some experimenting to find a method which shall bring a fair share of prosperity to the farmer—nobody well trained in science is afraid of an experiment as such—that's his everyday life. All science to-day is experimental. Why should not the science of government be experimental? The aim of the experiment in chemistry, in physics, in biology is to bring out the truth. Training in any or all of these sciences should fit us the better to apply any method no difference what its name, so long as it brings the truth. "Truth," said Coleridge, "is the highest good man can keep."

To be cultured one must be critical of life. To be justly critical one must have confidence in one's own reason, must find pleasure in working out one's own way of life and must prize the truth above anything else.

Life at Ursinus has taken on new value with the completion of the temple of science which you are about to dedicate. I congratulate President Omwake especially on this achievement, and all Ursinus students who are to have the opportunity of becoming devotees within the temple. I am not of that number

[10] T. H. Huxley, "Science and Education," p. 82, New York, 1898.

[11] W. A. Nielson, "Roads to Knowledge," Chapter on "Mathematics," p. 207.

who fear that a beautiful building will distract a man from his work. Beautiful architecture has a highly cultural effect; for daily contact with it brings a capacity to criticize the inferior styles and to appreciate the superior. Heaven knows we need such criticism in America! At the same time we must not lose sight of the fact that fine buildings and fine equipment do not make a college. There must be money to pay for brains. Superior men must be obtained and retained at all costs, even if it means that others must lose their jobs; for the service of the true scientist to these young men and women is the all important thing. They will miss an element in their culture which they can never obtain in any other way if they are not brought in contact with keen, productive minds. Science makes no claim to monopoly in the zeal for truth; but it does offer to-day the surest means of eliminating superstition and make-believe which still linger in the college atmosphere, of keeping one's feet on the ground, of gaining confidence in the processes of reason, and thereby strengthening the human spirit.

NOMENCLATURE OF THE HYDROGEN ISOTOPES AND THEIR COMPOUNDS

By E. J. CRANE[1]

THE OHIO STATE UNIVERSITY

THE separation in quantity of the hydrogen isotope of mass 2 has presented some interesting and very important nomenclature problems. The Nomenclature, Spelling and Pronunciation Committee of the American Chemical Society has been studying these. It has had the help of representatives of the American Physical Society. The committee has reached definite conclusions with reference to most features of the problem, but owing to certain circumstances thinks it best to make only an informal report in the form of this statement by its chairman at the present time. A similar study is being made in England. It is the hope of the committee that by submitting this informal preliminary report it will gain the advantage of suggestions from interested readers, with reference in particular to the more controversial points, as the question of symbols, and that it may be helpful in guiding usage during this early period of activity in which confusion in nomenclature is springing up. A formal report with definite recommendations can better be made a little later and it is promised.

It has been considered important to keep in mind certain general view-points in connection with this work. These take into consideration such matters as (*a*) the existence of many isotopes, (*b*) the fact that the isotopes of hydrogen are still forms of hydrogen and not new elements, (*c*) the effect of names and symbols on ease of thinking, (*d*) the teacher's viewpoint, (*e*) established nomenclature, (*f*) convenience and (*g*) indexing (this includes the use of indexes). An effort has been made to see the picture as completely as possible and with the broadest view.

Even so it has been considered justifiable to regard hydrogen as presenting a special case. Convenience seems almost to require special names and symbols for the hydrogen isotopes or at least for the isotope of mass 2. Hydrogen is a common element and its compounds are numerous (the whole field of organic chemistry is involved). The differences between isotopes of the other elements will no doubt be slight in comparison. Because of their large mass numbers other isotopes can be referred to by use of the element names followed by the mass numbers more conveniently than can hydrogen.

The committee is of the opinion that under most circumstances, as in compounds as a rule, just the name hydrogen and its symbol H will serve in place of a special name and symbol for the isotope of mass 1. As one committee member put it, "The fact that classical hydrogen has now been shown to have been slightly impure should not lead us to call it anything but hydrogen." It seems likely that there will be circumstances under which it will be helpful and in the interest of scientific exactness to have a special name and symbol for the hydrogen isotope of mass 1, but it is not proposed that the whole of our existing nomenclature for hydrogen and its many compounds shall be revised.

When the committee's work was started the isotope of mass 3 had only been predicted so that the committee did not include it in its program of work. It will no doubt be considered later.

For convenience the isotopes of mass 1 and mass 2 will be referred to as H^1 and H^2, respectively, in the remainder of this article.

Several names have been proposed for the isotopes. None of these has seemed preferable to the names protium and deuterium for H^1 and H^2, respectively, proposed by the discoverers of the isotopes, Harold

[1] Chairman of the Nomenclature, Spelling and Pronunciation Committee of the American Chemical Society.

C. Urey, G. M. Murphy and F. G. Brickwedde.[2] Discoverers have a traditional right to suggest names, and the careful consideration which preceded the exercise of this privilege took into account a number of possible names, including diplogen. Protium and deuterium have come into considerable use and it does not seem likely that they can be replaced or that they should be except in so far as protium is discarded in favor of hydrogen. None of the other proposed names seems to have gained any headway in usage, except that diplogen, proposed for H^2 by Lord Rutherford,[3] is being used to a considerable extent in Great Britain. Lord Rutherford's argument is that if deuterium is to be the name for H^2 then G. N. Lewis' suggestion of deuton as the name for the H^2 nucleus follows logically, and deuton "is liable in the spoken word to be confused with neutron." The name deuton has been accepted for use by many. The name hydrogen ("water-forming") is not unique as the name of an element with a -gen ending. The -ium ending as used in deuterium seems appropriate enough in view of the fact that the hydrogen ion is positive, like those of the metals. If diplogen were to be accepted for H^2 in order that diplon might logically be used for the H^2 nucleus then a continuation of this logic would lead to haplogen for H^1 and to haplon for the H^1 nucleus for which the name proton is well established.

The names hydrogen-*p* or hydrogen-*a* and hydrogen-*d* or hydrogen-*b* for H^1 and H^2, respectively, have a certain following. Perhaps, if the names protium and deuterium are adopted officially, hydrogen-*p* and hydrogen-*d*, respectively, might be approved for alternate use, particularly in view of the recommended names for compounds discussed below.

SYMBOLS

There is much difference of opinion both within and without the committee with reference to the most suitable symbols for the hydrogen isotopes. Each of the symbols below has certain advantages and a following:

Protium	Deuterium
H or H^1	H^2
H	D
H or Hp	Hd
H or H*p*	H*d*
H or H*a*	H*b*

Of a considerable number of interested chemists canvassed, including the 20 members of the committee (the ratio is approximately the same within and without the committee), approximately one third like H^2 for deuterium, another third like D, and H*d*, Hd and H*b* share the other third. Those in favor of D are rather emphatic about it. Others consider the use of D "particularly bad." A few object strongly to H^2. The committee finds it difficult to make a definite recommendation in the face of this situation. Perhaps more experience in the use of symbols and a wider canvass of opinion will help in the making of a decision. Time is needed. Opinion outside of the United States is being sought.

The symbols H^1 and H^2 have the advantage of fitting well with the general considerations given in paragraph 2 above labeled (*a*), (*b*), (*c*), (*d*) and (*g*). Perhaps the most striking of these is (*a*), as such a system would be universally applicable to the isotopes of other elements. These symbols picture the meaning well, and the retention of H as the letter of the symbol would help in the listing of hydrogen compounds by empirical formulas, as in indexes, a practise of growing importance with the increasing complexity of chemistry. They are not so convenient as certain other forms. For example, they present a difficulty in the reading aloud of formulas (one might read H_2^2O "H two up two O") and some difficulty in printing, and the fact that the French use superscripts where other chemists use subscripts in formulas might lead to confusion.

The symbol D for deuterium violates general considerations (*a*), (*b*), (*c*), (*d*) and (*g*) above for the sake of (*f*) (convenience). It is desirable for the commoner elements to have a single-letter symbol, and convenience is important. It tends often to be a determining factor. Is it important enough to counteract the other considerations? No doubt the importance of logical considerations can be overemphasized. I have noted that chemists who are talking and writing deuterium chemistry all day long, and perhaps eating and dreaming it, too, tend to use D. It has gotten into the literature perhaps as much as H^2. D must be considered as a strong candidate for official use.

Of the other symbols H*d* seems better than Hd because it helps in identifying deuterium as a form of hydrogen (Hd seems more like the symbol of a separate element, just as Hg is). H*d* fits in with all the general considerations mentioned above except (*a*). It does away with the reading-aloud difficulty, the printing difficulty and the difficulty presented by French practise. It has, however, been found somewhat awkward when used in the writing of formulas and can not be said to have as strong a following as do H^2 and D.

The symbols H*a*, H*b* and H*c* have been suggested as possibilities for protium, deuterium and tritium (H^3), respectively, along with the names hydrogen-*a*, hydrogen-*b* and hydrogen-*c* with the thought that

[2] *Jour. Chem. Physics*, 1: 512–13, 1933.
[3] *Nature*, 132: 955–6, 1933.

possibly such a symbolism and nomenclature could be applied universally to isotopes. The order of discovery, which would likely also be the order of abundance, would probably be the most satisfactory basis for such an allotment of letters for isotopes in general. Order of mass would not work so well because a lower or lighter isotope might unexpectedly be discovered after a higher one had been discovered and lettered with the resulting possibilities for confusion.

The Naming of Compounds

Compounds containing H^2 are being prepared and announced, and the number of these is likely to be large. These should be named systematically and with due attention to the general considerations so often referred to in this article. Some pretty bad names are getting into print. The committee hopes in particular to help in this phase of development by disclosing without delay a line of procedure which it favors in this connection.

In the naming of compounds containing one or more of the isotopes of hydrogen the compounds can either be regarded (*a*) as derivatives of some parent $CH_2H^2_2$ and (*b*) deuterium sulfide for H^2_2S. The latter substance in which hydrogen has been replaced by the isotope or isotopes or (*b*) as compounds of the isotope or isotopes, as (*a*) dideuteriomethane for practise works all right for a few simple compounds, but the former is the main reliance in systematic nomenclature. If applied, however, in the manner usually employed in organic chemistry where the names of radicals entering as substituents replacing hydrogen are introduced as a part of the names of the resulting compounds long and sometimes confusing names result. It would also result in the application to inorganic compounds of a typically organic idea.

With the mental attitude that compounds containing H^2 are after all compounds of a form of hydrogen the committee has sought a system of nomenclature which would result in the least possible change from established nomenclature for hydrogen compounds. Such a system should offer the least obstacle to our mental processes and to effective record-keeping. It is believed that a system has been found which will accomplish this purpose and which stands the test of general application. This system is a modification of one proposed by Willis A. Boughton.[4]

An example of Dr. Boughton's suggestion is the name benzene-p_2d_4 for $C_6H_2H^2_4$. This suggestion has been modified by the omission of "p" for most purposes and by the use of italic "*d*," thus benzene-d_4, and details of application of the system have been worked out (suggestions by Austin M. Patterson, C. D. Hurd and W. R. Stemen have helped greatly). The "*p*" can be used if desired in special cases so that the method is flexible. The following list of names[5] will serve as further examples of the application of the modified Boughton system. For contrast deuterio- names are also given.[6]

With reference back to the lettered general considerations given in the second paragraph it will be noted that the Boughton names conform with (*b*), (*c*), (*d*), (*e*), (*f*) and (*g*). It will also be noted that the other system results in many strange names which, as Dr. Patterson has stated, will have to be

[4] SCIENCE, 79: 159–60, 1934.

[5] It is recognized that the preparation of some of these compounds may not be realizable. The general applicability of the system is our present concern.

[6] If names of this sort are used the committee believes that the prefix should be spelled deuterio- and not deutero- or deuto- because deutero- and deuto- are both in use as prefixes with another meaning (second) in words, both chemical, as deuteroalbumose, and nonchemical. A similar reason makes protio- preferable over proto-.

	Boughton names	Deuterio names
NH^2_3	ammonia-d_3	trideuterioammonia
H^2Cl	hydrochloric acid-*d*	hydrochloric deuterioacid
$Na_2SO_4 \cdot 5H^2_2O$	sodium sulfate pentahydrate-d_{10} or —penta(hydrate-d_2)	sodium sulfate pentadideuteriohydrate
$NH_2H^2_2OH^2$	ammonium-d_2 hydroxide-*d*	dideuterioammonium deuterioxide
NHH^2OH^2	hydroxylamine-α,β-d_2	α,β-dideuteriohydroxylamine, or deuterioxyl deuterioamine
CH_3H^2	methane-*d*	deuteriomethane
$C_6H_5OH^2$	phenol-*d*	*O*-deuteriophenol or benzenedeuteriol
1, 3- $C_6H_4H^2CH_2H^2$	toluene-α,3-d_2	α,3-dideuteriotoluene
1, 2, 3- $C_6H_2H^2_2Cl$	chlorobenzene-2,3-d_2	1-chloro-2,3-dideuteriobenzene
$H^2HNC : CH^2 CH : CH \cdot CH : CH$	aniline-*N*,2-d_2	*N*,2-dideuterioaniline
$CH_2H^2CONHH^2$	acetamide-*N*,α-d_2	*N*,α-dideuterioacetamide
CH_3CH^2O	acetaldehyde-*d*	acetodeuterialdehyde
$CH_3CH_2OH^2$	ethyl alcohol-*d*	*O*-deuterioethyl alcohol or ethyl deuterioalcohol
$HOOCC : C(COOH^2)CH : CH^2CH : CH$	phthalic-4-*d* acid-2*d*	4-deuteriophthalic 2-deuterioacid

deciphered "to find the compounds old friends in disguise." A flood of deuterio- names, some of which would be confusing, would be a real handicap in organic chemistry.

An advantage of the Boughton names is their brevity. Contrast, for example, acetic-d_2 acid-*d* with dideuterioacetic deuterioacid or possibly protiodideuterioacetic deuterioacid (this last name, if it seemed necessary to designate protium in naming compounds, would by the Boughton system be acetic-pd_2 acid-*d*).

The objection may be raised to the Boughton system that it mixes names and symbols. There is plenty of precedent for this, however, in the naming of chemical compounds. The method grows in favor as one experiments with it. It apparently leads to the least possible change in established names, which is a consideration of fundamental importance. Another objection is the fact that "p" and "d" are in use in organic chemistry to designate para and dextro, respectively. However, "*p*" for para can be avoided and it is suggested that in the rare instance in which the dextro difficulty might arise the word "dextro" should be spelled out. The use of the "*d*" after names instead of before them will also help in keeping this sort of thing clear.

Opinion with reference to such expressions as "heavy water," "heavy ammonia," etc., is that this use of "heavy" is justified no matter what heavy isotope may be represented, whether it be an isotope of hydrogen or another element, and that such expressions, though not scientific, are handy for use in a generic sense.

The committee is willing to try to help individuals working in this field who may be confronted with nomenclature problems during this period when there is little or no precedent and it is so desirable for a consistent and effective nomenclature tool to be forged.

SCIENTIFIC EVENTS

THE CENTENARY OF PHOTOGRAPHY

ACCORDING to the London *Times*, a gathering took place at Lacock Abbey, Wiltshire, on June 16, to celebrate the centenary of the invention of photography and to do honor to Henry Fox Talbot, who, in 1834, working in that house, first succeeded in producing photographic impressions on paper. The Royal Photographic Society and other photographic bodies, especially in the west of England, were represented by their presidents and many members.

A large exhibition of Fox Talbot's early apparatus and of his negatives and prints was arranged in the gallery. The pictures included many of his "photogenic drawings," dated 1835 to 1840, before the introduction of a permanent fixing process, and among these was probably the earliest existing photograph—a window in Lacock Abbey, showing the tracery and the diamond leaded lights against the sky. There were a large number of examples of the calotype process, following the discovery of the latent image, and also an exhibition of Fox Talbot's later work in the direction of photo-engraving. Among other relics was a letter from Sir J. F. W. Herschel, in 1839, suggesting the term "photographic" in place of Fox Talbot's word "photogenic."

The *Times* states that the guests were received by Miss M. T. Talbot, granddaughter of the inventor, and the present lady of the manor, and an address on the personality of Fox Talbot was given by a grandson, Prebendary W. G. Clark-Maxwell, who said that it was while on his honeymoon in 1832 that Fox Talbot, having failed to sketch the scenery of Lake Como by means of the *camera obscura*, set himself definitely on the path which led to photographic discovery. The most puzzling feature of his career was his strong insistence on a series of patents, but it was not the need of money which impelled him, for he had no necessity on that score, nor was it greed, for that was not his nature, but it was in order to vindicate by a legal declaration the priority of his discovery.

Herbert Lambert, of Bath, said that, although Fox Talbot's first experiments were carried out in 1834, it was not until 1839 that, stimulated by the work of Daguerre, he announced his invention to the Royal Institution, a few days before Daguerre made his communication to the French Academy. It was a remarkable instance of two men working along independent lines and making what were really two different inventions with the same end in view, for, although Fox Talbot's calotype and the Daguerre process both used as their basis the sensitiveness of silver salts to light, the methods and chemical reactions were quite different. Daguerre used silvered plates which he sensitized with iodine and subsequently developed by mercury vapor, while Fox Talbot produced a sensitive paper which he developed with gallic acid and fixed with hyposulphite of soda. The really important invention by Fox Talbot was made in September, 1840, showing the way in which the latent image could be developed. It was this which distinguished his early photogenic drawings from the calotype or talbotype process which he patented in 1841.

A. J. Bull, president of the Royal Photographic Society, reviewed Fox Talbot's later work, culmina-

ting in the method of photographic engraving in 1858. He said that among the mass of material which Miss Talbot had now unearthed at Lacock Abbey were plates showing the use of fabrics of various textures which her grandfather had used in endeavoring to produce a grain for photo-engraving purposes. He ultimately obtained a very fine grain by folding a piece of black muslin on itself obliquely. Some of the specimen plates of this description were dated 1853, and a particularly interesting one recently unearthed at Lacock Abbey was a small and rather imperfect portrait of Huxley, which had the crossed-muslin grain.

VISIT OF AMERICAN FORESTERS TO GERMANY AND AUSTRIA

A GROUP of leading foresters and lumbermen from the United States will sail on July 26, under the auspices of The Oberlaender Trust of the Carl Schurz Memorial Foundation, Inc., to study the methods employed in Germany and Austria, by which private forests have become a profitable enterprise. The group includes Dr. Cedric H. Guise, professor of forest management at Cornell University, and Wilson Compton, secretary-manager of the National Lumber Manufacturers Association, Washington, D. C. Sustained forest production, as it has been practiced in these countries for many generations, as well as forest management, game preservation, selected cutting, reforestation, and markets for wood products will be studied.

Dr. Franz Heske, the director of the forestry school at Tharandt near Dresden, has been in the United States during the last three months, getting acquainted with conditions that face American foresters, and he will take charge of the group upon arriving in Germany. They will travel by bus from Berlin through eastern and southeastern Germany, into Czechoslovakia, Austria, and perhaps parts of Hungary. They will have an opportunity not only to see the forests, but to study costs, distribution of material and actual operations.

This tour is part of the program of the Carl Schurz Memorial Foundation, Inc., and The Oberlaender Trust, the purpose of which is to benefit the American people by studying those special achievements of the German and Austrian people which are outstanding, and introducing into the United States such as are adaptable to American conditions. Private forests for private profit is one of the fields in which the German people have excelled; and first-hand study of successful private forestry operations by influential American timberland owners will, in the opinion of the foundation, assist in developing the important program of permanent forest management now required by the Lumber Code.

The Trust's Advisory Committee in the field of forestry is composed of Dean Henry S. Graves, Yale University, School of Forestry; Dr. Cedric H. Guise, professor of forest management, Cornell University, and Earle H. Clapp, of the United States Forest Service. Mr. Ward Shepard, special adviser on land policies in the U. S. Office of Indian Affairs, has been of special help in making arrangements.

The trustees of The Oberlaender Trust are: Gustav Oberlaender, *president;* Carl W. Ackerman, dean of the School of Journalism, Columbia University; Dr. Haven Emerson, College of Physicians and Surgeons, Columbia University; Henry Allen Moe, executive director of the Guggenheim Foundation, and Mr. Wilbur K. Thomas, executive director of the Carl Schurz Memorial Foundation, Inc. Mr. Ferdinand Thun, of Reading, Pa., is president of the foundation.

EXHIBIT OF THE PATENT OFFICE AT THE CHICAGO WORLD'S FAIR

AT the World's Fair of 1934 at Chicago, the Patent Office, in its exhibit in the U. S. Government Building, surveys the American record of inventions.

Since the organization of our federal government 1,897,932 patents have been issued by the Patent Office up to January 1, 1934. Nearest to this record is France with 871,532. Great Britain has 797,153, Germany 583,728 and Italy 273,598. Canada rates high in inventiveness in proportion to population, with a total of 325,800 patents issued. Japan since its modernization has issued 83,361 patents and the U.S.S.R. has issued 63,992.

In the United States last year New York led with 8,017 patents. Illinois was next with 4,923. Ohio and Pennsylvania almost tied for third honors with 3,880 and 3,876, respectively. Mississippi is on the list with 49 patents for the year while Louisiana and Georgia have 141 each. A graphic chart shows the steady increase of the output of inventions in America. From 109 patents in 1836 to 56,856 in 1932 the rate of increase is almost unbroken, the chart lines forming nearly a perfect triangle.

Working models of inventions give a record of the past century of industrial advancement. In the exhibit is a compound steam engine model on which a patent was issued December 20, 1845, to John Ericsson, who later created the *Monitor* for the Federal Navy in the war between the states. Dated May 9, 1865, is a model of the four-barreled, water-cooled machine gun with which R. J. Gatling introduced a new method of wholesale destruction. A disappearing carriage for large cannon invented by James B. Eads, the bridge builder, is dated February 26, 1871. December 5 of the same year, is the date of a model by Thomas A. Edison of a machine for perforating tape to send telegraph messages.

The cases exhibiting patents issued include: the sewing machine, E. Howe, Jr., Sept. 10, 1846; the

typewriter, Sholes, Glidden and Soule, June 23, 1868; celluloid, John W. and Isaiah S. Hyatt, July 12, 1870; barbed-wire fencing, J. F. Glidden, November 24, 1874, and the telephone, Alexander G. Bell, March 7, 1876.

Other patents bear the names of T. A. Edison, phonograph or speaking machine, February 19, 1878; T. A. Edison, electric lamp, January 27, 1880; Otto Mergenthaler, machine for casting lines of type, September 16, 1890; Orville and Wilbur Wright, flying machine, May 22, 1906; Lee DeForest, vacuum tube, February 18, 1908.

THE ESTABLISHMENT OF A FOREST SHELTER BELT

IN an executive order, President Roosevelt has allocated $15,000,000 from the $525,000,000 drought relief fund for the beginning of work on a forest shelter belt a hundred miles wide and extending more than 1,000 miles through the heart of the drought area.

The estimated total cost is about $75,000,000, of which about 90 per cent. will go to farmers in the present drought areas for land and for plowing, fencing, planting and caring for the trees. The President's executive order follows:

By virtue of, and pursuant to, the authority vested in me by the emergency appropriation act, fiscal year 1935, approved June 19, 1934 (Public, No. 412, 73d Cong.), appropriating $525,000,000 to meet the emergency and necessity for relief in stricken agricultural areas, there is hereby allocated from the said appropriation the sum of $15,000,000 to the Secretary of Agriculture for the planting of forest protective strips in the plains regions as a means of ameliorating drought conditions.

In carrying out this order the Secretary of Agriculture shall have authority to make all necessary expenditures in the District of Columbia and elsewhere, including but not limited to the employment of such officers, experts and employees as he may find necessary, to prescribe their authorities, duties, responsibilities and tenure, and to fix their compensation, for the procurement or production of seed and planting stock, for planting operations, for the purchase or leasing of the lands to be planted, for technical investigations, for fencing and for rent.

The moneys herein made available shall be expended through such agencies, including corporations, as the Secretary of Agriculture may designate; and, with the consent of the state, county or municipality concerned, the Secretary of Agriculture may utilize such state and local officers and employees as it may deem necessary in carrying out this order.

The project will start at the Canadian border, a little to the east of a line drawn north and south through the center of North Dakota. It will run in almost a straight line into the Texas Panhandle, cutting across the two Dakotas, Nebraska, Kansas and the western arm of Oklahoma. Altogether it will call for the planting of 1,820,000 acres in trees. The land between the belts of trees will continue to be used for farming purposes. The area to be affected immediately will be approximately 20,000,000 acres.

There will be a hundred windbreaks, each about seven rods wide, covering fourteen acres out of each square mile. Only the land planted in trees will be acquired by the government through purchase, lease or cooperative agreement. Some of the land is already in the hands of federal, state and local governments. It is estimated that the cost of acquiring privately owned land will not be high, and that to at least some extent farmers will be willing to lease the land indefinitely at no charge in return for the benefits they will receive.

The present plan is to begin planting this autumn on sections of the windbreaks which fall on publicly owned land and where climatic conditions seem suitable. The Forest Service is preparing to establish a special field force in a central location for the conduct of the work. One of the first tasks will be to establish nurseries throughout the region.

REPORT OF THE CHIEF OF THE OFFICE OF EXPERIMENT STATIONS

FINDING the use for which any type of land is best fitted and the most profitable way to get submarginal acres out of cultivation and into grass, forests, recreational or other uses, thus bringing production into line with consumption, is a national trend at the agricultural experiment stations of the various states, according to the annual report of Dr. James T. Jardine, chief of the Office of Experiment Stations.

In southern Illinois soil surveys are being used to speed reforestation. Two national forests of nearly 600,000 acres are planned. If they are included in the reforestation program, they will give work to hundreds of men and should return more money to the state than it has been receiving from taxes on this land.

Soil surveys at the New Jersey experiment station seek to promote the most profitable use of land under the highly specialized agriculture of that state. With reduction of cultivated lands in Massachusetts, the experiment station is urging a return of the poorer acres to forests and recreation uses. There are now 40,000 acres of public forests in the state. The Massachusetts station also has shown that stony upland pastures can be profitably improved with a small outlay for fertilizer.

In Connecticut the station at Storrs has developed a system of pasture improvement by fertilizing, seeding, management and removal of brush which is being adopted throughout the state. Ranchmen of Hawaii have been able to improve their ranges with information on grasses and forage crops furnished by the Hawaii station. Experiments at the Arkansas station

show that much of the land is better suited to timber than to farming; at least timber raising would be just as profitable. Land use studies at the Georgia station will enable the state to set up new agricultural programs where much of the land has been abandoned. In Kentucky the suggestion has been made that enlargement of private forests into good sized tracts would make protection against fires easier, would promote greater skill in the care of growing trees and would make harvesting of timber more economical.

The Minnesota station is participating in soil erosion control in the rolling lands in the southeastern part of the state and much unproductive peat and bog land is being converted into good pasture and hay land through the planting of reed canary grass. In Nevada farm land is being classified in the Walker River Irrigation District, the information to be used in keeping some districts from financial ruin. The Ohio station found that in Vinton County more than a fourth of the land once in farms now lies idle and that the public funds going into the county from state and federal governments in a ten-year period equal the value of the farm land. Soil surveys in Rhode Island will provide information for reforestation and back-to-the-land movements, and determine areas suitable for subsistence farming. The Wisconsin station and others have entered on systematic programs for utilizing lands so as to adjust production to consumption.

These are examples and not a summary of the work being done. They illustrate the national effort to solve the problem of land utilization.

SUMMER MEETING OF THE BOTANICAL SOCIETY OF AMERICA AT TORONTO

THE summer meeting of the Botanical Society of America at Toronto on June 18 to 20 was attended by about a hundred and twenty-five botanists. The program in Toronto included inspection of the botanical laboratories at the university and the displays in the Royal Ontario Museum, a dinner at Hart House, and an address by Professor M. L. Fernald, of Harvard University, on the persistence of pre-glacial species of plants in the northeastern states and southeastern Canada.

An excursion to the Scarborough Bluffs east of Toronto afforded a view of the various glacial deposits of the region, which were explained in detail by Dr. A. P. Coleman, veteran glacial geologist, by a field lecture in a pouring rain. The fossil remains of plants, which occur abundantly at various levels in these deposits, have proved that interglacial climates were at times warmer than those of the present and brought such austral plants as the papaw and the osage orange as far north as Toronto.

Nearly a hundred persons left Toronto by automobile on the morning of June 19 for the excursion to the Bruce Peninsula, situated between Lake Huron and Georgian Bay. A brief stop was made at Hi-Pot-Lo Park to observe the rich natural vegetation and the numerous pot-holes. Luncheon was served in the dining hall of Ontario Agricultural College, where the extensive range of greenhouses was inspected. The party reached Owen Sound in the evening and visited a colony of the rare hart's-tongue fern, *Scolopendrium vulgare*. The following day the excursion was continued among the bogs, dunes and limestone ridges near the Lake Huron shore of the Bruce Peninsula. Among the plants collected here were several species, such as *Pinguicula villosa, Carex scirpoidea* and *Anemone multifida,* whose presence supports the belief that the peninsula was not covered by the Wisconsin ice sheet.

SCIENTIFIC NOTES AND NEWS

IT is announced in *Nature* that on July 2 the following were elected honorary fellows of the Royal Society of Edinburgh to commemorate the completion of its one hundred and fiftieth year: *Foreign,* Björn Helland-Hansen, Geophysical Institute, Bergen; Professor Bernardo Houssay, professor of physiology, National University of Buenos Aires; Professor Frank R. Lillie, professor of zoology and embryology, University of Chicago; Professor T. H. Morgan, professor of biology, California Institute of Technology; Professor Paul Sabatier, professor of chemistry, University of Toulouse; Dr. Theobald Smith, formerly director of the department of animal pathology of the Rockefeller Institute for Medical Research, Princeton. *British,* Professor H. E. Armstrong, emeritus professor of chemistry, Imperial College of Science and Technology, City and Guilds (Enginering) College, London; Professor J. S. Haldane, director of the Mining Research Laboratory, and honorary professor, University of Birmingham; Professor Karl Pearson, emeritus Galton professor of eugenics, University of London; Professor E. B. Poulton, lately Hope professor of zoology, University of Oxford; Sir G. Elliot Smith, professor of anatomy, University College, London; Professor W. W. Watts, emeritus professor of geology, Imperial College of Science and Technology, London.

THE Board of Trustees of the University of Illinois has made an appropriation to the Graduate School for the publication of the first volume of the works

of Dr. G. A. Miller, who retired as professor of mathematics in 1931. A committee has been appointed to collaborate with Professor Miller in preparing the manuscript and in seeing it through the press. It is expected that this volume will be published during the first half of the year 1935. It will contain about five hundred pages and will cover Professor Miller's publications prior to 1900. It is estimated that six volumes of approximately five hundred pages each will be required for the collected scientific works.

DR. T. D. A. COCKERELL, since 1906 professor of zoology at the University of Colorado, having reached the age limit, retires this summer, with the title of professor emeritus.

AN account of the life and work of Dr. Arthur H. Compton, professor of physics in the University of Chicago, is printed in the issue of *The New York Herald Tribune* for July 22. This is the first of a series of articles on distinguished American men of science, to be printed each Sunday.

AT the one hundred and twelfth annual commencement of the Philadelphia College of Pharmacy and Science the degree of master of pharmacy was conferred on Dr. Walter A. Bastedo, president of the U. S. Pharmacopoeial Convention, member of the eleventh revision committee of the Pharmacopoeia, New York physician and teacher of medicine; on Dr. Horatio C. Wood, Jr., professor of pharmacology and therapeutics in the School of Medicine of the University of Pennsylvania; on Edmund N. Gathercoal, professor of pharmacognosy in the College of Pharmacy of the University of Illinois, Chicago, chairman of the sixth revision committee of the National Formulary and of the National Pharmaceutical Research Conference, and on Dr. Oscar W. Bethea, professor of clinical medicine in the School of Medicine of Tulane University.

BOWDOIN COLLEGE conferred on June 21 the degree of doctor of science on Dr. Benjamin F. Kingsbury, head of the department of embryology and histology of the Cornell Medical College at Ithaca. The citation said: "Eminent scientist, distinguished both for research and teaching, which has placed many students of biology and many students of medicine in his debt."

SIR HENRY WELLCOME, head of the Wellcome Research Foundations of London, England, was granted the degree of doctor of science at the annual commencement exercises of the Marquette University, Milwaukee, on June 13. Sir Henry Wellcome is a native of Wisconsin.

DR. JAMES ANGUS DOULL, professor of hygiene and public health in the School of Medicine of Western Reserve University, has been elected to honorary membership in the Royal Sanitary Institute of Great Britain. This membership is limited to thirty, of whom seven are Americans.

THE *Journal* of the American Medical Association states that the Japanese Academy Prize for 1933, which is the highest prize for scientific work, was given to Dr. Hiroshi Kon, of the pathologic section of the medical department of the Hokkaido Imperial University for his research on the silver reaction of protoplasm.

AT the Ithaca meeting of the Society for the Promotion of Enginering Education, Professor C. C. Williams, of the State University of Iowa, was elected its president for the coming year. Professor Williams succeeds Professor W. E. Wickenden, president of the Case School of Applied Science. Other officers elected were Professor H. P. Hammond, of the Brooklyn Polytechnic Institute, and Dean G. C. Shaad, of the University of Kansas, as vice presidents. Professor F. L. Bishop, of the University of Pittsburgh, was reelected secretary, a position he has held for the last twenty years, and W. O. Wiley, of John Wiley and Sons, New York, was elected treasurer.

THE American Section of the Society of Chemical Industry announces the election of the following officers to serve for the year ending June 1, 1935. *Chairman,* Robert J. Moore; *Vice-chairman,* W. D. Turner; *Honorary Secretary,* Foster D. Snell; *Honorary Treasurer,* J. W. H. Randall, and in addition, five new members were elected to the executive committee to take the place of retiring members. Those newly elected are Lincoln T. Work, Wallace P. Cohoe, Albert E. Marshall, James G. Vail and Charles A. Lunn.

DR. WALTER S. RITCHIE, assistant professor of agricultural chemistry in the College of Agriculture of the University of Missouri, has been appointed professor and head of the department of chemistry at the Massachusetts State College. During the past year Dr. Ritchie has directed the work of the analytical laboratory at the University of Missouri.

DR. M. STANLEY LIVINGSTON, for the past two years reesarch associate in physics at the University of California, has been appointed instructor in physics at Cornell University.

DR. P. CALIXTE DAGNEAU, professor of clinical surgery in the Faculty of Medicine at Laval University, Quebec, has been appointed dean, to succeed the late Dr. J. M. Arthur Rousseau.

PROFESSOR S. E. WHITNALL has been appointed to the chair of anatomy at the University of Bristol in

succession to Professor Edward Fawcett, who retired at the end of the academic year. Professor Whitnall at present holds the chair of anatomy at McGill University and will be unable to fill the chair in Bristol until January, 1935. Dr. Fawcett has been asked to take charge of the department as emeritus professor for the autumn term. Professor Brocklehurst has been appointed dean of the faculty of medicine in succession to Professor Fawcett, and Professor A. E. Trueman, dean of the faculty of science in succession to Professor W. E. Garner.

PROFESSOR S. W. HUNTON, who for fifty-one years has been head of the department of mathematics at Mount Allison University, Sackville, New Brunswick, retired at the close of the academic year.

DR. JAMES P. LEAKE, senior surgeon, U. S. Public Health Service, who has been relieved from duty in the division of sanitary reports and statistics, has been assigned to duty in the division of scientific research.

DR. ORLO H. MAUGHAN, extension assistant in farm management at Cornell University, has taken up his work in Washington as a statistical assistant for the Farm Credit Administration.

DR. RALPH L. MILLER, stationed for four years at the laboratory of the Bureau of Entomology at Orlando, Florida, has resigned to accept a position with the Freeport Sulphur Company, of New Orleans.

DR. HAROLD C. TAYLOR, formerly assistant in psychology, Institute of Human Relations, Yale University, has joined the staff of the Industrial Relations Division of The Proctor and Gamble Company as technical assistant on research.

DR. WILLIAM K. GREGORY, professor of vertebrate paleontology at Columbia University, and Dr. George E. Brewer, formerly professor of surgery there, have been appointed official representatives of the American Museum of Natural History to the International Congress of Anthropology and Ethnology, which will meet at London from July 30 to August 4.

DR. HOWARD T. KARSNER, director of the Institute of Pathology of Western Reserve University, plans to go to Europe, where he will attend the triennial conference of the International Society for Geographic Pathology, meeting in Utrecht, Holland, of which he is a member of the executive committee of five members. Later he will visit laboratories in London, Cambridge, Hamburg, Freiburg and Strasbourg.

PROFESSOR T. G. YUNCKER, of the department of botany of DePauw University, who spent 1933–1934 in botanical research in the Hawaiian Islands, is spending this summer with several of his students in Yucatan.

DR. JOHN WISHART, reader in statistics at the University of Cambridge and statistician for the Rothamsted Experimental Station, on July 16 delivered a lecture in the U. S. Department of Agriculture on "Statistics in Agricultural Research."

AT the annual meeting of the District of Columbia Alumni Chapter of the Society of Sigma Xi, held on May 21, the following scientific men were presented as members-elect, each delivering an address bearing on his special field: Leason Heberling Adams in chemistry, physical chemist, Geophysical Laboratory, Carnegie Institution of Washington; Adam Giede Böving in zoology, senior entomologist, Bureau of Entomology; David James Price in engineering, principal engineer in charge of the Division of Chemical Engineering, Bureau of Chemistry and Soils.

THE tenth National Shade Tree Conference will be held at the Carnegie Institute, Pittsburgh, on August 30 and 31. Nationally known authorities will present papers in their respective fields. Each paper will be followed by discussion. The program is so arranged as to be of value to both practical and scientific workers. Educational and commercial exhibits will be shown. It is hoped that the conference will prove of interest to commercial shade tree experts, and to entomologists, physiologists, horticulturists, pathologists and other scientific workers whose problems are in the shade tree field.

YENCHING UNIVERSITY, Peiping, has been granted a three-year subsidy of $45,000 by the British Boxer Indemnity Fund in support of the ceramics research program in the department of chemistry. At the same time a sum of $100,000 was granted the Peiping Research Institute toward new laboratory buildings for physics and chemistry.

THE trustees of the Bernhard Baron Charitable Trust have informed the British Empire Cancer Campaign, through its chairman, Lord Reading, that they have made a grant of £10,000 to the Empire Day Appeal. The money will be put in a special fund to be called the "Bernhard Baron Cancer Fund."

ACCORDING to the *Journal* of the American Medical Association, a fund of about $200,000 has been created by anonymous donors to establish and maintain a department at the Hebrew University, Jerusalem, for cancer research. Study will be directed first toward radiobiology, physiologic chemistry and the study of cells and tissues. At a recent meeting of the American members of the board of governors of the institution in New York, it was voted to nominate Dr. Ludwig Halberstaedter, formerly of the staff of the Cancer Institute of Berlin, now with the Rothschild Hadassah Hospital in Jerusalem, as head of the department of radiobiology; Dr. Georg Goldhaber, for-

merly Dr. Halberstaedter's assistant, as his assistant in the new department; Dr. H. A. Krebs, formerly of Berlin and now at the University of Cambridge, England, as head of the department of physiologic chemistry, and Dr. Leonid Doljansky, formerly of the Institute of Pathology, of the University of Berlin, and now at the University of Copenhagen, as head of the new department to be devoted to tissue culture research and morbid anatomy.

ACCORDING to *Nature*, in the House of Commons on June 29, Mr. W. Ormsby-Gore, first commissioner of works, moved the second reading of the bill for the setting up of a National Maritime Museum in the buildings recently occupied by the Greenwich Hospital School. The cost of adapting the vacant school buildings is estimated at £29,000 and Sir James Caird has generously offered to defray this sum. Sir James has already given large sums towards the restoration of H.M.SS. *Victory* and *Implacable* and presented the museum with the Macpherson Collection of naval prints. There is nowhere, said Mr. Ormsby-Gore, where one can study the history of our maritime adventure and development, and no attempt has yet been made to illustrate conveniently for the general public the immense field of British maritime endeavor, historical, technical, geographical and commercial, including not only the exploits of the Royal Navy but also of the mercantile marine. A Board of Trustees with the Earl of Stanhope as chairman has been appointed and the post of director has been offered to Professor G. A. R. Callender, of the Royal Naval College, Greenwich.

DISCUSSION

THE PLEISTOCENE LONG VALLEY LAKE IN EASTERN CALIFORNIA[1]

THE object of this notice is to place on record some observations concerning part of the Pleistocene and Recent history of a basin that is soon to become a reservoir site for the City of Los Angeles. If present plans are completed, a portion of the basin floor will be flooded and thus concealed from further investigation.

Long Valley, situated in southern Mono County, California, about 15 miles southeast of Lake Mono, occupies the lower part of a wide reentrant in the eastern front of the Sierra Nevada. This mountain-circled embayment, in which are located the headwaters of Owens River, appears on the topographic map[2] to be a northwestward extension of Owens Valley, that deep, narrow graben between the Inyo Range and the Sierra Nevada.[3] Structurally, however, the two basins are distinctly separate units. At present, the floor of Long Valley is at an elevation of about 6,900 feet above sea level, and "hangs" more than 2,400 feet above the bottom of the Owens graben, from which it is separated by an extensive, uplifted and tilted fault block, known as the Volcanic Tableland. Across the tableland, Owens River has cut an imposing gorge. Headward erosion in this canyon, and consequent lowering of the outlet of Long Valley, has brought an end to the existence of an ancient lake that once occupied the valley floor. By constructing a dam across the upper entrance to the Owens River canyon, the engineers of the City of Los Angeles plan to restore in part the original conditions and create a reservoir on the site deserted by the Pleistocene waters.

Professor C. F. Tolman has noted the former existence of a lake in Long Valley.[4] He was probably the first to report the presence of wave-cut terraces at about the 7,100 foot level along the valley sides. Since Tolman's observations were made, some interesting evidence concerning the existence and age of the extinct lake has accumulated. Although the investigation has not been completed in the desired detail, it is proposed to present briefly the evidence and some conclusions.

The former existence of the lake is established beyond doubt by the presence of lacustrine deposits, at least 100 feet in maximum thickness, on the floor of Long Valley. The significance of these sediments was probably first appreciated by Professor Blackwelder.[5] The lowest exposed lacustrine beds, consisting of clay, silt and marl, with some diatomite, have an exposed thickness of about 50 feet, but they have not been completely dissected, because the outlet of the valley has not yet been sufficiently lowered. These materials are so easily eroded that Owens River has been able to establish a broad, meadow-carpeted valley in them since the disappearance of the lake.

Overlying the finer, weakly consolidated sediments, is from 5 to 50 feet of coarse, cross-bedded, tuffaceous sandstone, usually with opaline cement. This rock has been deposited in deltas, built out into the lake by tributary streams that were fed, in part, by copious thermal springs, a few of which are still extant. The formation is quite resistant to erosion, but since it probably never completely covered the valley floor, it may not have been a serious obstacle to the removal

[1] Published by permission of the California State Division of Mines.

[2] Mt. Goddard, Mt. Morrison and Bishop Sheets, U. S. Geol. Survey.

[3] Adolph Knopf, "Geologic Reconnaissance of the Inyo Range and Eastern Slope of the Southern Sierra Nevada, California," U. S. Geol. Surv., Prof. Paper 110, pp. 90-91, 1918.

[4] C. F. Tolman, unpublished manuscript.

[5] Eliot Blackwelder, personal communication.

of the softer materials, except along some of the tributary streams, where it slowly yields to undermining.

The terraces noted by Tolman have, in many places, been eroded into soft, unconsolidated materials, with the result that they are now very indistinct,[6] but nevertheless real. Several levels can be made out in some places. On the eastern, or tableland side of the valley, there are many faint terraces, the highest of which is several hundred feet above the highest similar feature yet found on the western side. This seems to indicate that during the life of the ancient lake, there was a slow, probably intermittent, uplift of the volcanic tableland, or a sinking of the valley floor.

Well-rounded pebbles, usually of dense, flow-banded rhyolite, but occasionally of obsidian, are scattered along the eastern terraces, and are regarded as additional evidence of wave action at these sites in the past. The rounding of the pebbles is farthest advanced on the lower terraces.

There are two lines of evidence regarding the time at which the lake existed. When light conditions are most favorable, terraces can be seen etched into some of the glacial moraines that project from the mouths of canyons in the Sierra Nevada. These moraines were formed during the Blackwelder's Tahoe age;[7] hence the valley floor was deeply covered with water during or subsequent to Tahoe (Iowan) time. Whether or not the same condition existed before the Tahoe epoch, the writer can not say. The closing stages of lacustral history are recorded by domes of lithoid and dendritic tufa[8] along the lowest terraces on the southeastern side of the valley. At one place, the tufa deposit crosses a short, dry wash, some 30 feet deep, evidently eroded during a temporary lowering of the lake level. The tufa in the bottom of the gully shows such slight evidence of corrasion that it is tempting to regard this level as having been finally abandoned by the lake only a few hundred years ago. Under the present climatic conditions, however, water very seldom flows in this wash, and the slight corrasion of the tufa may therefore represent all the time since the Tioga (Wisconsin) epoch.[9] For this reason, the closing stages in the history of Long Valley Lake are tentatively placed in, or shortly after, Tioga time, perhaps 10,000 or 20,000 years ago.

[6] One sharp, distinct terrace in unconsolidated material does exist on the southwestern side of the valley, but it is thought that this has been caused, or at least greatly accentuated, by recent movement along one of the bounding faults of the Sierra Nevada.

[7] Eliot Blackwelder, "Pleistocene Glaciation in the Sierra Nevada and Basin Ranges," *Bull. Geol. Soc. Amer.*, 42: 865–922, 1931.

[8] I. C. Russell, "Quaternary History of Mono Valley, California," U. S. Geol. Surv., 8th An. Rept., Pt. 1, pp. 310–315, 1886–87.

[9] Eliot Blackwelder, *loc. cit.*, p. 881.

Besides giving evidence concerning the approximate time at which the lake disappeared the tufa domes are of interest because they indicate that such deposits can be formed, at least locally, along the shores of a water body that has an outlet.

Although more details are desired, the existence and approximate age of Long Valley Lake are proved. At the highest stage it may have been about 17 miles in length and 8 miles across at the widest place. The greatest depth attained could not have been less than 250 feet.

EVANS B. MAYO

CORNELL UNIVERSITY

DO CHROMATOPHORE WALLS CAUSE MOVEMENT OF PIGMENT GRANULES?

IN a recent reply to Sumner by Mast,[1] there is expressed an opinion that " . . . a chromatophore is somewhat like a branched, heavy-walled rubber tube closed at the distal ends of the branches and at the other end joined to a heavy-walled rubber bulb filled with pigment granules suspended in a fluid, and that movement of the granules in the chromatophore is due to action in the heavy walls which surround the cavity containing the granules." A further statement is, " . . . the distribution of the granules in a chromatophore is due to action in the wall which surrounds the cavity containing the granules . . ." With this conception of the method of bringing about changes in the amount of pigment exposed to view in chromatophores, reasons are given why one should or should not use certain terms relative to these changes.

I have not been particularly concerned in this controversy over terminology; but if the use of terms is to be determined on the basis of the functioning of the chromatophore or parts of these cells, I believe there should first be fairly common agreement among investigators as to what actually takes place during "distribution" and "congregation" of the granules of pigment.

In my study of chromatophores, I have been impressed by the unusual thinness of the walls. Although the terms "thick" and "thin" are only relative and the actual measurement of the thickness of the walls of chromatophores has not been done, as far as I know, I see no reason for calling the walls thick. Furthermore, I have found no reason for believing that the walls of the chromatophore cause the pigment granules to move. In my study of the epidermal melanophores of frog tadpoles in living, uninjured tissue, in which observations were made continuously over periods of hours and with magnifications up to 1,000 diameters, the employment of an ocular micrometer did not reveal the slightest change in diameter

[1] SCIENCE, March 16, 1934.

of any part of the pigment cell during the distribution or congregation of the pigment. The movement of the pigment as a whole or of the individual granules, whether going into or out of the branches of the cell, did not suggest to me that any part of the melanophore was acting in the capacity of a rubber bulb.

As the pigment moved out into the branches, some granules usually reached the extremities of the cell before others had little more than begun to move; and, as the process continued, the cell branches received more and more pigment. In this movement of the pigment, a few granules might move more rapidly than others for a time, only to be overtaken by those that were following. No one granule appeared to maintain a constant rate of movement. Similar movements were observed when the pigment moved out of the branches, some granules lingering for a time and then by more rapid movement overtaking others ahead. I have seen no evidence to support the statement by Mast[2] that pigment granules move on definite paths through the cytoplasm.

EARL H. HERRICK
LOUISIANA STATE NORMAL COLLEGE
NATCHITOCHES

PANCREATECTOMY—A WARNING[1]

THE nutritional condition of an animal when pancreatectomy is performed determines to a large extent the length of survival if no insulin is given. Chaikoff, Macleod, Markowitz and Simpson[2] have emphasized the longer survival of thin dogs than fat ones after this operation. The Allen treatment for human diabetes probably owes its success to the inanition of the patients.

In studies of the relation between other endocrine glands and the pancreas, animals frequently submit to one operation prior to the pancreatectomy. This preliminary operation often leads to a state of undernutrition which is conducive to long survival following removal of the pancreas. At least this is the interpretation of Ring and Hampel (unpublished) concerning the occasional longer survival of their cats, in which th[illegible]oidectomy or unilateral adrenalectomy preceded extirpation of the pancreas. Even the better results obtained by depancreatizing animals in two stages depends in part upon this nutritional factor.

Work on adrenalectomized diabetic cats has recently been reported by Long and Lukens.[3] Their results are strikingly similar to those which Ring and Hampel obtained on diabetic cats with Eck fistulae. One such animal survived for 17 days after the withdrawal of insulin. Near the end of this period the glycosuria disappeared and convulsions were a frequent occurrence unless food was kept constantly by the animal. These convulsions were promptly relieved by glucose ingestion. Animals in better nutritional condition survived a shorter time. The writer was unable to maintain the weight of the animals with Eck fistulae, so that he has never felt justified in drawing any conclusions from this work.

G. C. RING

[2] SCIENCE, November 10, 1933.

[1] From the Laboratories of Physiology in the Harvard Medical School.

[2] I. L. Chaikoff, J. J. R. Macleod, J. Markowitz and W. W. Simpson, *Amer. Jour. Physiol.*, 74: 41, 1925.

[3] C. N. H. Long and F. D. W. Lukens, SCIENCE, 79: 569, 1934.

THE TROPICAL RAT FLEA IN THE INTERIOR OF THE UNITED STATES

IN his book "Insects and Disease of Man," Fox (1925) states that the tropical rat flea, *Xenopsylla cheopis,* is not known to occur in the interior of the United States. We have been able to find no reports of this flea from this part of the country (Iowa), although rat flea data taken by members of the United States Public Health Service have shown that it commonly occurs on rats at our seaports.

In February of this year we took one specimen which we identified as *Xenopsylla cheopis* from a rat shot on the dumping ground of the city of Ames. During July we shot six more rats on the grounds and took from them 259 fleas. Examination of these showed that 257 of them were *Xenopsylla cheopis* and 2 were *Ceratophyllus fasciatus.* We are indebted to Dr. H. E. Ewing, of the Bureau of Entomology, United States Department of Agriculture, to whom we sent a male and a female flea, for confirming our determination of *Xenopsylla cheopis.*

Thus it appears that the tropical rat flea is well established in the interior of the United States. Whether it will persist here is problematic. Rothschild (1910) states that although the insect is practically cosmopolitan, it can not apparently flourish in temperate and cold climates, but Fox and Sullivan (1925) found it as far north as Boston every month of the year from December 1, 1922, to November 10, 1923.

As others have pointed out, the presence of the flea host in itself does not constitute a menace to a community, for bubonic plague has not made its appearance along the Atlantic seaboard where *Xenopsylla cheopis* occurs on rats in considerable numbers. If, however, bubonic plague should be introduced into the Middle West through shipping on the Mississippi River, or otherwise, there now exists the possibility of its becoming endemic among rats, for its vector seems to be well established.

ROBERT L. ROUDABUSH
ELERY R. BECKER

IOWA STATE COLLEGE

UNIVERSITY OF ROCHESTER FIJI EXPEDITION

THE University of Rochester expedition under the auspices of the Bernice P. Bishop Museum was organized for geological research in the Lau Islands of eastern Fiji for the months of February to September of this year. These islands are particularly interesting because of their limestones. Many of the limestones have been considerably altered by atmospheric agencies but careful examination has brought to light localities where they are unchanged. As a result excellent collections of fossil foraminifera, corals, echinoids, mollusks and other organisms have been obtained. A study of these will undoubtedly disclose the geological age of the islands and relate them to other land areas of the Pacific region. Geological maps have been prepared of the five islands of the Exploring Group in northern Lau and Mango, Tuvuthá and Katafanga. In all 18 islands have been studied in some detail from Ongea in the southern end of the group to Vanua Mbalavu in the northern. Preparation of the findings will be made at the University of Rochester and the U. S. National Museum. Publication will be made by the Bishop Museum of Honolulu.

J. EDWARD HOFFMEISTER
HARRY S. LADD

SCIENTIFIC APPARATUS AND LABORATORY METHODS

RATIONAL TRAY SIZES FOR GEOLOGIC SPECIMENS

MANY types of geologic and other natural history materials require display and storage trays of various sizes, even for the same class or group of specimens. As used in laboratories and museums these trays commonly have dimensions fixed by local custom but usually not systematically related in the various sizes nor determined by an inclusive rational arrangement.

The following scheme of tray sizes was recently devised and provides the following characteristics:

(a) Trays of all sizes have a rectangular shape, the length being about 40 per cent. greater than the width and the ratio the same for all sizes. The trays are thus all geometrically similar figures.

(b) The sizes are so arranged that the length of one size is equal to the width of the next larger size.

(c) The length and width, respectively, of a given tray are doubled and the area quadrupled in the tray second larger in the series.

As a necessary consequence of the specifications above, the following relations appear:

(d) The ratio of length to width for all trays is the square root of two, approximately 1.414.

(e) The ratio of homologous linear dimensions in successive trays of the series is the same, 1.414, and of the areas is 2.000.

(f) Moreover, each tray not only has half or twice the area, respectively, of the trays next larger or smaller but can be fitted exactly into the same space by turning through ninety degrees.

(g) The area relationship and possibility of fitting into common space extends to the second removed, larger and smaller sizes with the area ratios of four and indefinitely according to the same geometrical law.

Any base size may be used in starting the series, though in a given museum the various departments should have little difficulty in agreeing on a common series, since the size ratio is small and the member nearest to a given traditional or precise requirement will differ but little from it. The table below gives dimensions for such a series based on the approximate length of one decimeter or four inches and recorded in both English and metric units.

RATIONAL SCHEME OF TRAY SIZES
(LINEAR RATIO $\sqrt{2}$, AREA RATIO 2)

Tray designation	English decimal (inches)			English fractions (inches)		Metric (centimeters)		
	Width	Length	Area	Width	Length	Width	Length	Area
a	1.4	2.0	2.8	1–13/32	2	3.5	5.0	17.7
b	2.0	2.8	5.6	2	2–13/16	5	7.1	35.4
c	2.8	4.0	11.3	2–13/16	4	7.1	10	70.7
d	4.0	5.6	22.6	4	5–19/32	10	14.1	141
e	5.6	8.0	45.2	5–19/32	8	14.1	20	283
f	8.0	11.3	90.4	8	11–5/16	20	28.3	566
g	11.3	16.0	181	11–5/16	16	28.3	40	1131
h	16.0	22.6	362	16	22–19/32	40	56.6	2262
i	22.6	32.0	723	22–19/32	32	56.6	80	4525

For greatest convenience the drawers in cabinets in which such trays are placed should have the inside dimensions of one of the larger members of the series, such as 22.6 by 32 inches. Or, one of the dimensions of the drawer can be taken as a base on which to determine the submultiple tray sizes. Fig. 1 shows a

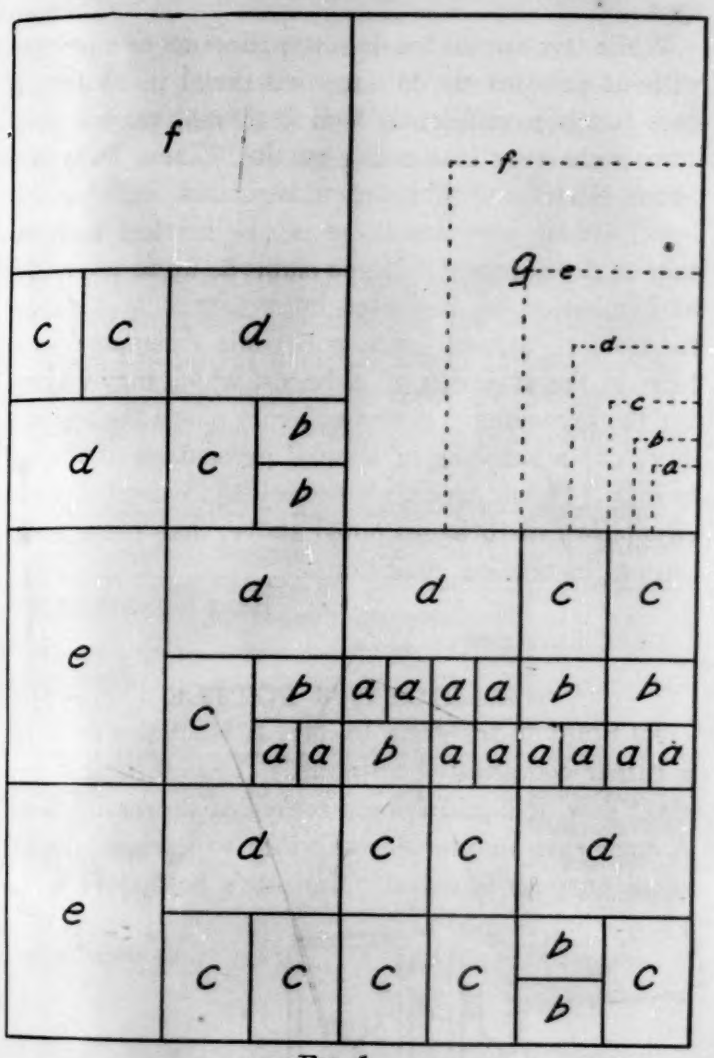


FIG. 1.

drawer of size *i* in which various sized trays of this series from *a* to *g* are fitted. Within the space *g*, the relative sizes of other trays are shown in dotted lines. No doubt such an arrangement or one in part comparable to it has been devised and used by some one long since, but since the basic scheme does not seem to have been generally in use, the foregoing presentation may be of value to others. The advantages of the plan are apparent; adaptations to special requirements are readily worked out.

CHESTER K. WENTWORTH

BOARD OF WATER SUPPLY
HONOLULU, HAWAII

APPARATUS FOR STUDYING THE EFFECT OF INCREASED ATMOSPHERIC PRESSURE UPON THE DEVELOPING HEN EGG

A STUDY of the effects of unequal mechanical pressures upon developing amphibian eggs was among the earliest investigations of the experimental embryologists, but so far as I know no studies, other than those reported by the writer, have been made upon the effects of increased atmospheric pressure upon the avian egg. The apparatus described herein is the outgrowth of several years of experiment, the earliest reports of which were published in 1927.[1] Without describing all the failures and fruitless experiments I shall pass to the present apparatus, which serves its purpose reasonably well. Naturally if one should build a completely new apparatus it would be more compact and convenient than the one described here. The illustrations presented herewith were drawn to

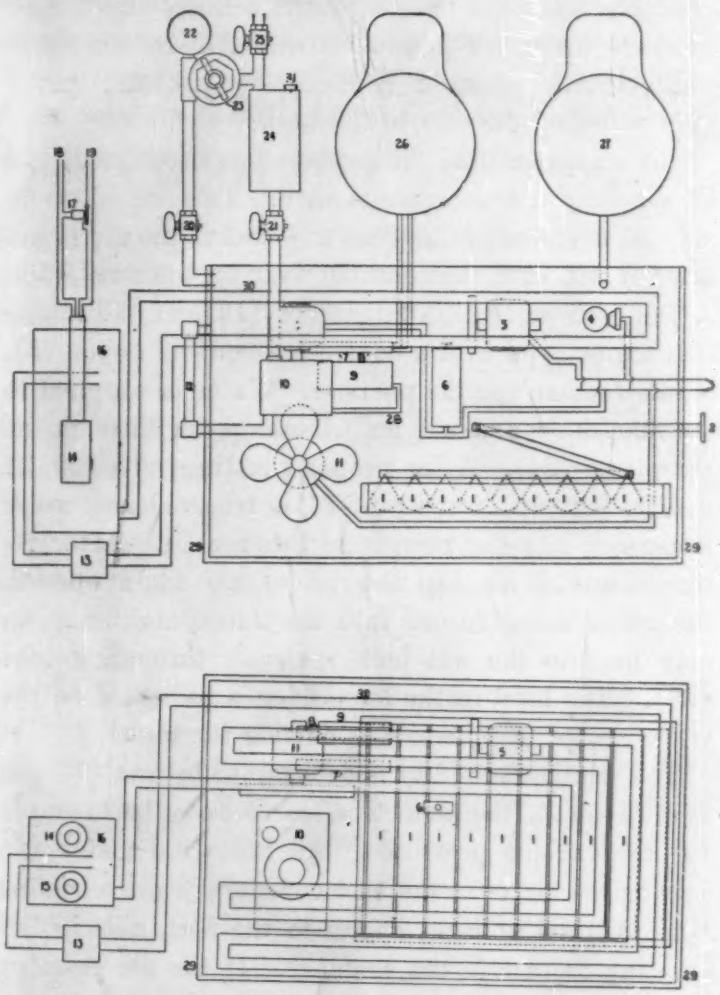


Fig. A. Schematic drawing of incubator with front wall removed. Fig. B. View from above with the lid removed. 1, Egg turner; 2, lever arm for egg turner; 3, electric circuit 110 v; 4, light (for illumination only); 5, fan to drive air over thermometer bulbs; 6, humidity control; 7, bulb of wet bulb thermometer; 8, bulb of dry bulb thermometer; 9, water reservoir for wet bulb thermometer; 10, reservoir of humidifier; 11, fan for circulation of air in incubator; 12, water gauge (outside of incubator); 13, water pump; 14, thermoregulator; 15, electric heater; 16, hot water supply tank; 17, mercury switch (6 volts through thermoregulator); 18, 6 volt line; 19, 110 a. c. to heating element; 20, air valve; 21, air valve; 22, air gauge; 23, pressure regulator; 24, water receptacle; 25, air valve; 26, dual recording thermometer; 27, recording air pressure gauge; 28, tube to supply water to thermometer reservoir from the humidity reservoir; 29, casing; 30, hot water coils; 31, port of entry for water.

[1] *Jour. Elisha Mitchell Sci. Soc.*, 42: 188.

scale and the various dimensions can, if desirable, be calculated on the basis of length (inside measurement 32 inches).

The casing (29), made of boiler plate riveted and welded together, was designed to resist 150 pounds of pressure per square inch. In the front wall (not shown) there is a hand hole of sufficient size to permit the placing of the eggs on the egg turners (1), and to make such adjustments of controls as may be necessary. The top is securely bolted on and is never removed except to repair the apparatus within. The entire tank is properly insulated with asbestos.

Compressed air up to 40 pounds of pressure is available from the building service lines, and higher pressure up to 80 pounds is available by a special compressor. There is a recording pressure gauge (27) attached directly to the tank.

The compressed air in use here has been dried, and of necessity a humidifier is used. This would probably be necessary in any set up—but if the air is not dried it will save considerable wear on the humidifier. A Bahnson cigar case humidifier (10), of the induction motor type with a control element of paper (6), is satisfactory for the purpose. Water is supplied to the humidifier and wet bulb thermometer through the receptacle (24). After properly setting valves 20, 21 and 25 the cap of the pipe 31 is removed and water is poured into the receptacle through 31. After replacement of the cap the valves are again opened, the water being forced into the humidifier tank. It may pass to the wet bulb reservoir through a tube (28). The level in the humidifier is indicated on the water gauge (12), which is outside the tank.

The relative humidity is determined by wet (7) and dry (8) bulb thermometers, corrections being made for the various pressures. An induction motor fan (5) drives air over the thermometer; while a second fan, (11) set at right angles to the first, aids in circulating the air in the chamber. If the air chamber were perfectly airtight the air would become too humid for satisfactory incubation, owing to the evaporation of water from the wet bulb, so provision must be made for slight leakage.

Contact points corrode quickly under pressure, so the temperature controls are placed on the outside of the incubator and in the supply tank (16) for the circulating of water which serves to furnish the heat for the incubator. For heating about 15 feet of one half inch brass pipe (30) are used, this being ample when the room temperature is maintained at from 60° to 70° F.

The water is circulated through the system by a motor-driven pump (13). The water is drawn from the bottom of the supply tank and returned to the top since less temperature variation occurs in the incubator under these conditions.

The eggs are placed on an egg turner (1), which is controlled by a bar (2) passing through the wall to the outside. The rack is sufficiently removed from the floor to permit free circulation of air under the eggs.

While this apparatus does not function as efficiently without pressure as do our commercial incubators, it does function sufficiently well to give at various pressures some very interesting results. These have been noted elsewhere,[2] but are summarized here as follows: Under pressure there is (1) marked acceleration of development in some embryos up to seven days of incubation, as indicated by weight; (2) a failure to develop normal extra-embryonic circulatory systems in the majority of embryos, which may account for the exceedingly high death rate about the eleventh day; (3) a hatching of a small percentage of the embryos; (4) no more abnormalities, except for the circulatory disturbance noted above, than occur under normal incubation conditions.

BERT CUNNINGHAM

DUKE UNIVERSITY

MARIOTTE'S BOTTLE

IN SCIENCE for June 15, Mr. J. H. Wales describes a rather complicated apparatus for obtaining a constant flow of liquid from a source of decreasing head. A somewhat simpler device which will accomplish the same purpose is called "Mariotte's bottle" (Fig. 1).

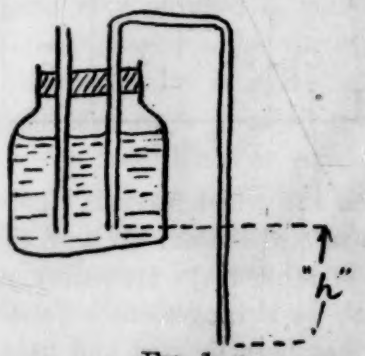


FIG. 1.

As the diagram shows, a stoppered reservoir is supplied with an air inlet and a siphon. When the siphon is working, the pressure at the bottom of the air inlet tube is obviously just atmospheric, for if it were greater air would not enter; it can not be less because it is in contact with the atmosphere. If the entrance to the siphon is at this same depth, then it will always be supplied with liquid at atmospheric pressure and will deliver a flow under the constant head "h," regardless of the changing depth within the reservoir.

E. L. MCCARTHY

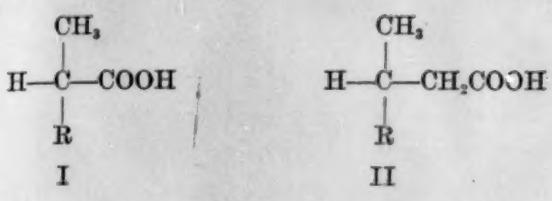
YERKES OBSERVATORY

[2] Reported to the N. C. Acad. Science in 1933 and 1934.

SPECIAL ARTICLES

ON THE EXTENT OF THE VALIDITY OF THE "RULE OF SHIFT"

THE members of two configurationally related homologous series of substances of the general structure



are characterized by the following properties:

In type I the partial rotations of the COOH group and of the rest of the molecule are of the same sign. In type II they are of opposite sign. If the carboxyl group in the first series of substances is levorotatory, it is dextrorotatory in the second. The question arose as to the effect of the substitution of the hydrogen atom of the carboxyl group by a nitrophenyl group on the rotations in the visible region of the spectrum of the members of each group and on the partial rotations of the respective groups attached to the asymmetric carbon atom. This inquiry is of significance in connection with the question of the extent of the validity of the so-called "Rule of Shift," which postulates that in configurationally related substances an identical substitution brings about a shift of rotation in the same direction.

In order to obtain the desired information the rotatory dispersion of several substances of types I and II were studied. The results are summarized in the table.

A scrutiny of the table reveals that in the first group of substances, measured either in homogeneous state or in heptane, the substitution causes a shift of the rotations to the left in all members, but in the second group of substances measured in heptane, the lower members on substitution respond with a shift of the rotation to the left, whereas the higher members show, under the same circumstances, a shift to the right. From the study of the rotatory dispersion curves of the members of II, it becomes evident that in the lower members the substitution affects principally the second contribution, whereas in the higher members the first contribution is enhanced to a higher degree.

Thus, caution has to be exercised when the "Rule of Shift" is made use of for correlating the configura-

MAXIMUM MOLECULAR ROTATIONS OF CORRELATED p-NITROPHENYL ESTERS OF α-SUBSTITUTED ACETIC AND PROPIONIC ACIDS

Acids		Free acid $[M]_{5892.6}^{25}$		p-Nitrophenyl esters of the acids $[M]_{5892.6}^{25}$	Sign of contribution first	Sign of contribution second	Character of dispersion curve
2-Methylbutyric acid	(1)	−18	in heptane	−45.2			
			homogeneous	−41.8			
2-Methylcaproic acid	(1)	−24.3	in heptane	−66.3	−	−	normal
			homogeneous	−57.8	−	−	"
3-Methylvaleric acid	(1)	−10.4	in heptane	−18.0	+	−	abnormal
			homogeneous	−20.1	+	−	"
3-Methylcaproic acid	(1)	+ 3.6	in heptane	+ 0.86	+	−	normal
			homogeneous	− 5.11*	+	−	abnormal
3-Methylheptylic acid	(1)	+ 6.1	in heptane	+ 6.1			
			homogeneous	+ 0.85			
3-Methylcaprylic acid	(1)	+ 8.1	in heptane	+10.8	+	−	normal
			homogeneous	+ 4.2*	+		"

*In a short note published by Levene and Meyer this value was reported with incorrect sign and the value reported for 3-methylcaprylic acid in homogeneous state was erroneous. (See P. Stevens, *Jour. Am. Chem. Soc.*, 56: 997, 1934). This error is unaccountable in view of the fact that the polariscopic readings were made by two observers, G. M. Meyer and R. E. Marker.

tions of substances whose two component partial rotations are of opposite sign.

P. A. LEVENE
ALEXANDRE ROTHEN
G. M. MEYER

THE ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH
NEW YORK, N. Y.

PSEUDORABIES AS A CONTAGIOUS DISEASE IN SWINE

PSEUDORABIES is recognized as an acute, infectious, highly fatal disease of cattle, cats and dogs. The causative virus is readily transmissible by inoculation to rabbits, guinea-pigs, rats and mice as well as to other animals less commonly used for experimental purposes. Pruritus and rapid death after a relatively short incubation period are salient features of the disease. Pseudorabies has not been found to be contagious among any of the common laboratory animals nor among cattle, cats or dogs, and its method of spread under natural conditions is unknown.

The susceptibility of domestic swine to pseudorabies was not extensively investigated by earlier workers; Schmiedhoffer[1] was unable to infect pigs experimentally. On the other hand, von Ratz[2] observed the disease occurring naturally in wild swine. The writer[3,4] has found that the virus administered subcutaneously produced in swine a mild disease in marked contrast to the uniformly fatal form which it produces in other species. The susceptibility of domestic swine to pseudorabies has since been observed by other workers[5,6,7] and the disease has been found to occur naturally in this species in Holland and Hungary as a rather mild ailment. The clinical features of swine pseudorabies induced by subcutaneous inoculation are malaise, decreased appetite and a 4 to 6 day febrile reaction; rarely, indefinite symptoms of central nervous system involvement were observed.

Further work has shown that the virus when administered intranasally produces a similar disease. In one instance intranasal inoculation was followed by a pneumonia. The mild disease described above may follow the repeated feeding of large amounts of virus or the intramuscular injection of small amounts. In the latter case a weakness or paresis of the inoculated leg may be detected. Injected intracerebrally under ether anesthesia into swine the virus produces marked central nervous system symptoms and death in from 36 to 96 hours.

In addition it has been observed that pseudorabies in swine is contagious. In a series of 9 experiments normal swine were placed in the same isolation pen with pigs experimentally infected either subcutaneously or intramuscularly with pseudorabies virus. In 8 of these experiments the exposed swine developed pseudorabies. In the single negative experiment it is believed, from what is known now, that the infected pig was removed before it had reached the stage at which the disease was communicable. Although the Hungarian virus was used in most of these experiments, the Iowa strain (mad itch) was also found capable of transferring from swine to swine by contact.

Pseudorabies in swine infected by pen exposure closely resembled the disease seen in pigs inoculated subcutaneously. None of the experimental animals died and none appeared dangerously ill. The nature of the illness contracted by exposure was proven in every case either by the demonstration of virus during the course of the disease or of specific virucidal antibodies in the blood serum following recovery. The latent period between the time of first exposure and the onset of symptoms varied from 4 to 11 days, probably depending upon the stage of the disease in the inoculated animal when the normal animal was placed in the pen.

In studying the mode of transmission of pseudorabies in swine it was found that hog lice played no rôle. Neither could virus be demonstrated in the urine, feces or salivary glands of infected pigs, indicating that the saliva and the excreta were unimportant as regards the transmission of the disease. Study of the distribution of the virus in swine killed early in an illness contracted by exposure finally suggested its portal of entrance. In such animals virus could be demonstrated only in the nasal washings. To test the possibility that virus spread from pig to pig by way of the nose, experiments were conducted in which the nasal passages of intramuscularly inoculated swine, as well as of those being exposed, were washed out daily with sterile physiological saline. By means of the inoculation of small amounts of these washings subcutaneously into rabbits it was found that virus was present in the nasal passages of inoculated swine on the sixth day, which is usually the last day of temperature elevation, and that it might persist for a day or two longer. It was not present

[1] J. Schmiedhoffer, *Z. Infektionskrankh., Haustiere,* 8: 383, 1910.
[2] S. von Ratz, *Z. Infektionskrankh., Haustiere,* 15: 99, 1914.
[3] R. E. Shope, *Jour. Exp. Med.,* 54: 233, 1931.
[4] R. E. Shope, *Proc. Soc. Exp. Biol. and Med.,* 30: 308, 1932.
[5] A. Burggraaf and L. F. D. E. Lourens, *Tijdschr. Diergeneesk.,* 59: 981, 1932.
[6] A. Braga and A. Faria, *Revista de Vet. e Zootech.,* 18: Nos. 3–4, 1932, referred to in *Bol. Instit. Vital Brazil,* No. 16, 1934.
[7] P. Remlinger and J. Bailly, *Bull. L'Acad. Vet. France,* 6: 169, 1933.

previous to the sixth day nor later than the eighth day following inoculation.

Virus was present in the nasal washings of swine infected by exposure on the day prior to the elevation of temperature above 40° C.; that is, on the last day of the period of incubation, and thereafter throughout the period of illness. The brain and viscera of one pig, killed after its nasal washings had contained virus of 4 consecutive days, were free of virus, while in another pig, killed after its nasal washings had contained virus for 6 consecutive days, virus was demonstrable in the lung and a mixture of spleen and liver but not in the blood, brain or other tissues tested. The nasal washings of one animal, under observation for 3 weeks, contained virus on the last day of the incubation period, on all the 6 days that the animal was ill, and on the first 4 days of convalescence.

The experiments just summarized indicate that in pseudorabies in swine the nose serves as the portal for the entrance and exit of the virus. They suggest that swine may be an important reservoir for the maintenance of pseudorabies infection because of the facts that the disease in swine is highly contagious, that it is not fatal for this species among all its hosts, and that it is of so mild and ill-defined a nature that it may escape notice, or, if it is noted, be incorrectly diagnosed. It is readily conceivable that the escape of this virus from its swine reservoir may be responsible for the sporadic and highly fatal cases of pseudorabies among cattle in the swine-raising states of the Middle West. Further evidence to support this possibility will be reported in detail later.

RICHARD E. SHOPE

THE ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH
PRINCETON, N. J.

CROSSOVERS IN MALE DROSOPHILA MELANOGASTER INDUCED BY HEAT*

THE long-known effect of heat in increasing the amount of crossing-over[1] in Drosophila females led the senior author some years ago to attempt to induce crossing-over in the male by use of the same agent. The undertaking failed. Perhaps others have essayed the same task without success. In view of the recent production of crossovers in the male through the agency of x-rays by Patterson and Suche[2] and by Friesen,[3] it seemed worth while to try once more the effect of heat. This time the effort has been successful.

The experiments began with a cross between wild-type flies and a multiple third-chromosome stock possessing the characters thread, scarlet, curled, stripe, sooty and claret, which we have been calling "theca," though it lacks the character rough eye contained by the stock originally called theca. The F_1 larvae from this cross were subjected, at ages ranging in different experiments from 0 to 6 days, to temperatures varying from 33° to 35° C., for periods of one to eight days. Males which survived this treatment were mated to theca females, one male and several females in each culture bottle. Non-crossover sperms from treated males would produce either wild-type or theca individuals among their offspring; crossover sperms would produce flies possessing some but not all of the mutant characters of the theca stock.

In the early experiments the flies were not classified with respect to thread or stripe. In one of these, 21 surviving F_1 males were back-crossed to theca females. One of these males gave rise, among a total progeny of 182 flies, to three crossover individuals, two of them scarlet curled sooty males, one a claret female. As a check upon the classification of these flies they were all mated back to theca individuals. The two scarlet curled sooty males gave only theca and scarlet curled sooty offspring by this cross, while the claret female yielded chiefly theca and claret classes with small numbers of crossovers in each of the delimited regions. Thus was the original classification of the crossover flies verified.

In a later series of similar experiments thread, but not stripe, was included in the classification. Of the many heat-treated cultures, one yielded 13 surviving males, three of which on being mated to theca females produced crossovers. Two of these three males produced one crossover each as follows: 1 curled sooty claret; 1 sooty claret.

The remaining one of the three is mentioned separately because it produced 32 crossover offspring, all thread scarlet, without any of the complementary class (curled sooty claret). This latter result is so unusual as to suggest contamination. No stock of thread scarlet is being maintained in this laboratory, so if contamination were the explanation it would have to come about in an indirect manner. Moreover, the conduct of the experiment seems to preclude that possibility. As in most of these experiments, the parents were transferred from bottle to bottle at frequent intervals, and the heat-treated male, after having been with one group of females for a number of days, was placed with a new group. The male which produced the 32 crossover offspring was thus introduced into two matings. Some of the crossovers appeared in two successive cultures from the first group of females, some in the first culture from the second group of females. If, therefore, contamination were the explanation of these 32 apparent crossovers, the same con-

* Contribution from the Zoological Laboratory of the University of Michigan.

[1] H. H. Plough, *Jour. Exp. Zool.*, 24: 147–209, 1917.
[2] *Genetics*, 19: 223–236, 1934.
[3] SCIENCE, 78, 2031, 513–514, 1933.

tamination would have had to occur in two groups of females obtained virgin at different times. While we have no explanation of the failure of one complementary class to appear, we believe that contamination as by a previous uncontrolled mating of the theca females is excluded.

In the remaining experiments, somewhat more extensive and systematic than the first two series, complementary crossover classes appeared when even moderate numbers of crossover individuals were obtained. Eight out of 127 males that survived the heat treatment in this series produced crossover offspring, as shown in Table I.

Crossovers have thus been produced in each of the regions of the third chromosome marked by the genes used, except that between thread and scarlet. Ques-

TABLE I

Designation of male	Number of crossovers	Composition of crossover offspring
1	1	e^s ca
2	1	th st cu e^s
3	3	ca
4	12	th st
	2	cu e^s ca
5	1	th st
	1	th st cu e^s
	2	th st cu·
	3	e^s ca
6	1	th st
7	1	e^s ca
8	6	th st
	5	cu e^s ca

tions relating to the relative frequency of crossing-over in the several regions, frequency of crossing-over in females resulting from these crossovers, the optimum age and intensity of treatment are being reserved until more data are secured.

A. FRANKLIN SHULL
MAURICE WHITTINGHILL
UNIVERSITY OF MICHIGAN

SUSCEPTIBILITY TO POISON IVY AND POISON OAK[1]

AN investigation of the susceptibility of 101 adult city-dwelling persons to the skin-irritating properties of poison ivy and poison oak has been made. Water-free alcoholic extracts of the dried leaves of these plants were made and diluted in varying concentration. They were tested by placing small disks of blotting paper, moistened with the extract, on the forearms of the persons examined. The patches were covered with a cellophane shield and secured by adhesive tape. They were left in place for twenty-four hours. The ivy and oak extracts were tested simultaneously one on each arm. The weakest extracts were applied first and the result examined after seven days. If no reaction, consisting of a persistent erythema

TABLE I

Irritant	Concentration	Power of concentration (1+log) A	Per cent. persons susceptible B	B/A
Poison oak	1	1	24	24
	3.3	1.5	36	24
	10	2	42	21
	100	3	65	22
Poison ivy	1	1	27	27
	3.3	1.5	42	28
	10	2	47	24
	100	3	60	20
	3000	4.5	75	17

and itching, was observed, the next stronger solutions were applied. The proportion of the reactions in those persons tested at each level of concentration was calculated and corrected to percentage of the total number tested by multiplying by the percentage of persons immune to the next lower level. The figures are shown in Table I. The 1:100 dilution of the original extract was arbitrarily chosen as the unit of concentration.

It is seen from this that the number of persons susceptible to these extracts tends to vary as the logarithm of the concentration of the irritant. In other words, the proportion of the population affected increases arithmetically as the concentration of the irritant is increased geometrically, which is similar to the action of physiological stimuli in general as expressed by the Weber-Fechner law.

W. C. SPAIN
J. M. NEWELL
MIRIAM MEEKER

[1] From the Division of Applied Immunology of the Department of Medicine, New York Post-Graduate Medical School and Hospital.

BOOKS RECEIVED

ARTHUR, JOSEPH C. *Manual of the Rusts in United States and Canada.* Pp. xv+438. Illustrated by George B. Cummins. Purdue Research Foundation, Lafayette, Indiana.

NEAL, HERBERT V. and JAMES F. PORTER. *Vitalism and Mechanism, a Discussion.* Pp. 87. Authors.

PALMER, CLAUDE I. and CHARLES W. LEIGH. Fourth edition. *Plane and Spherical Trigonometry.* Pp. xiv+229. Illustrated. McGraw-Hill. $1.50.

STANFORD, ERNEST E. *Economic Plants.* Pp. xxiii+571. 376 illustrations. Appleton-Century.

WILLIS, BAILEY and ROBIN WILLIS. *Geologic Structures.* Third edition. Pp. xviii+544. 202 figures. McGraw-Hill. $4.00.